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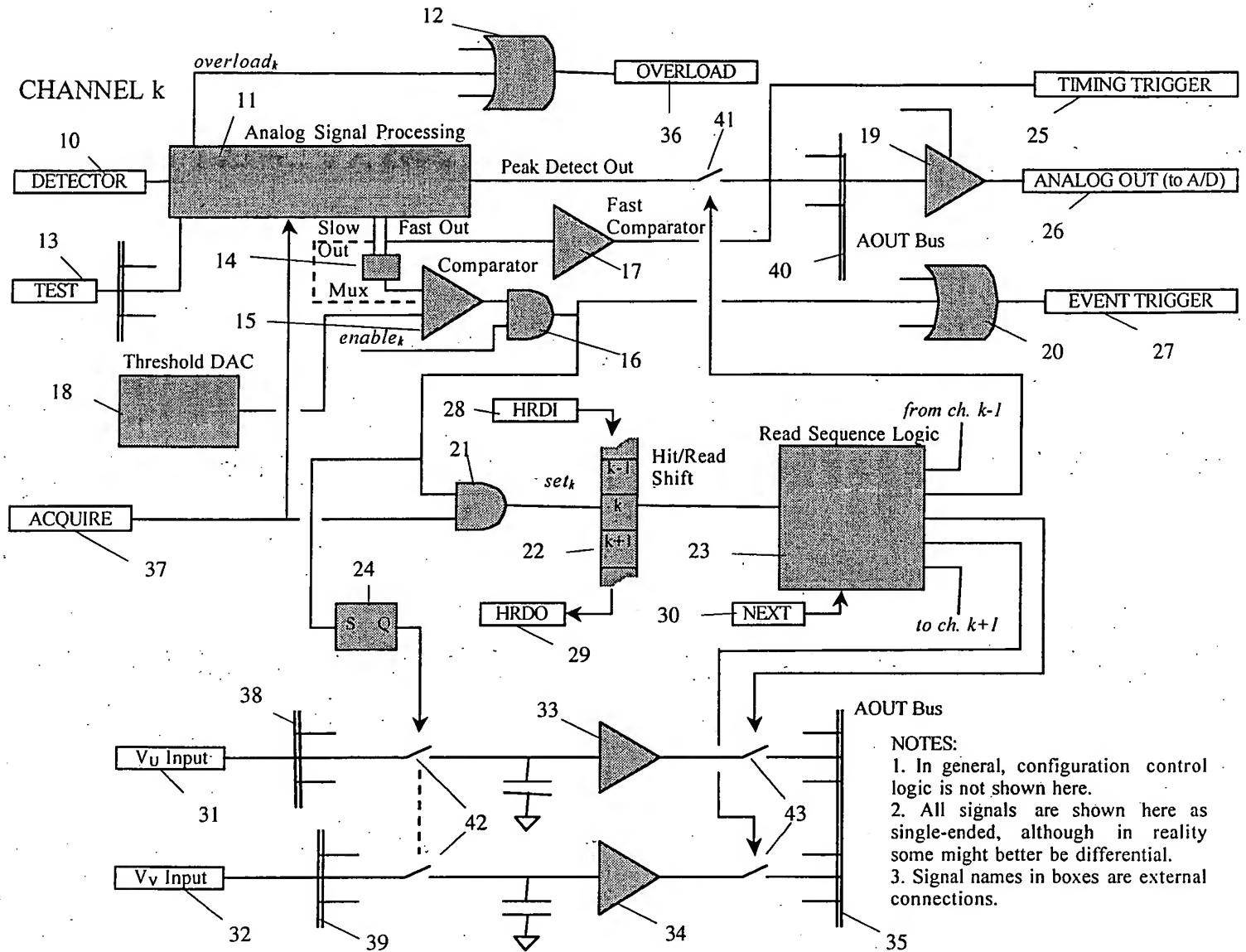


FIG. 1

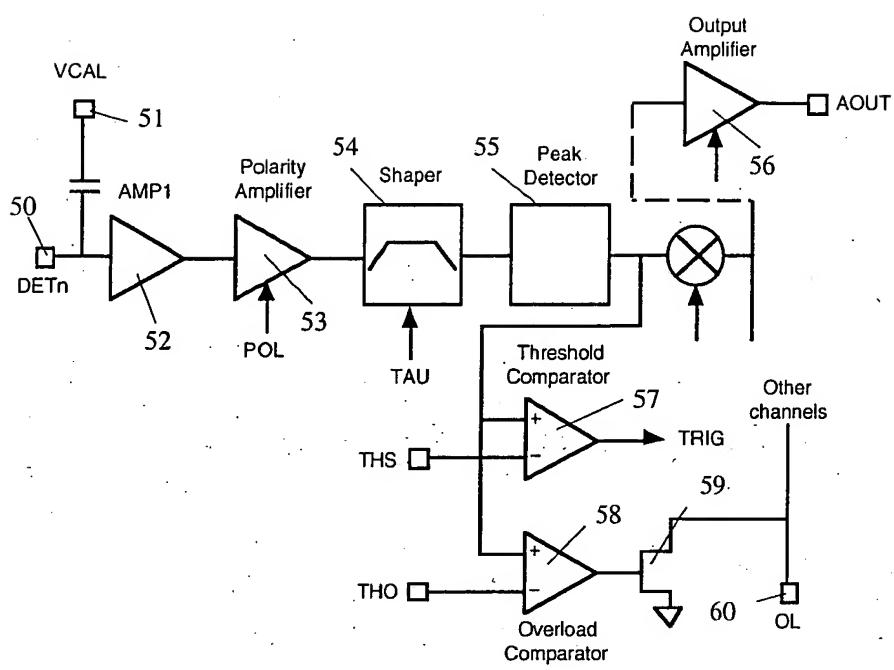


FIG. 2

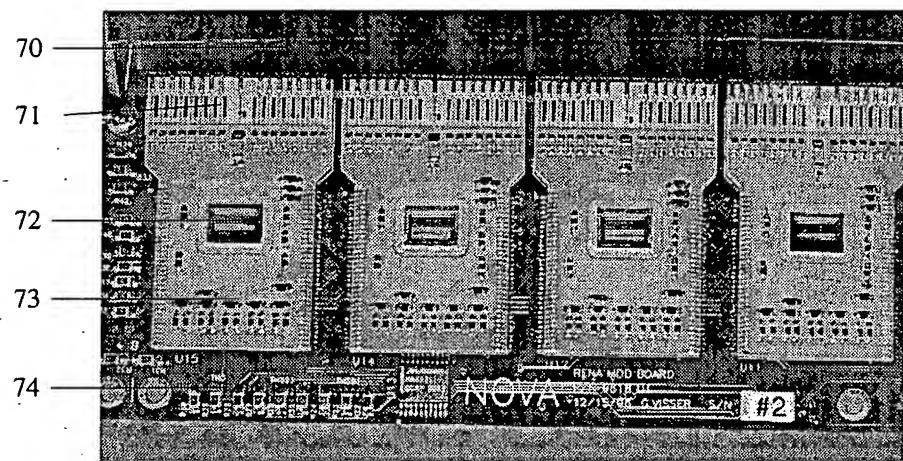


FIG. 3

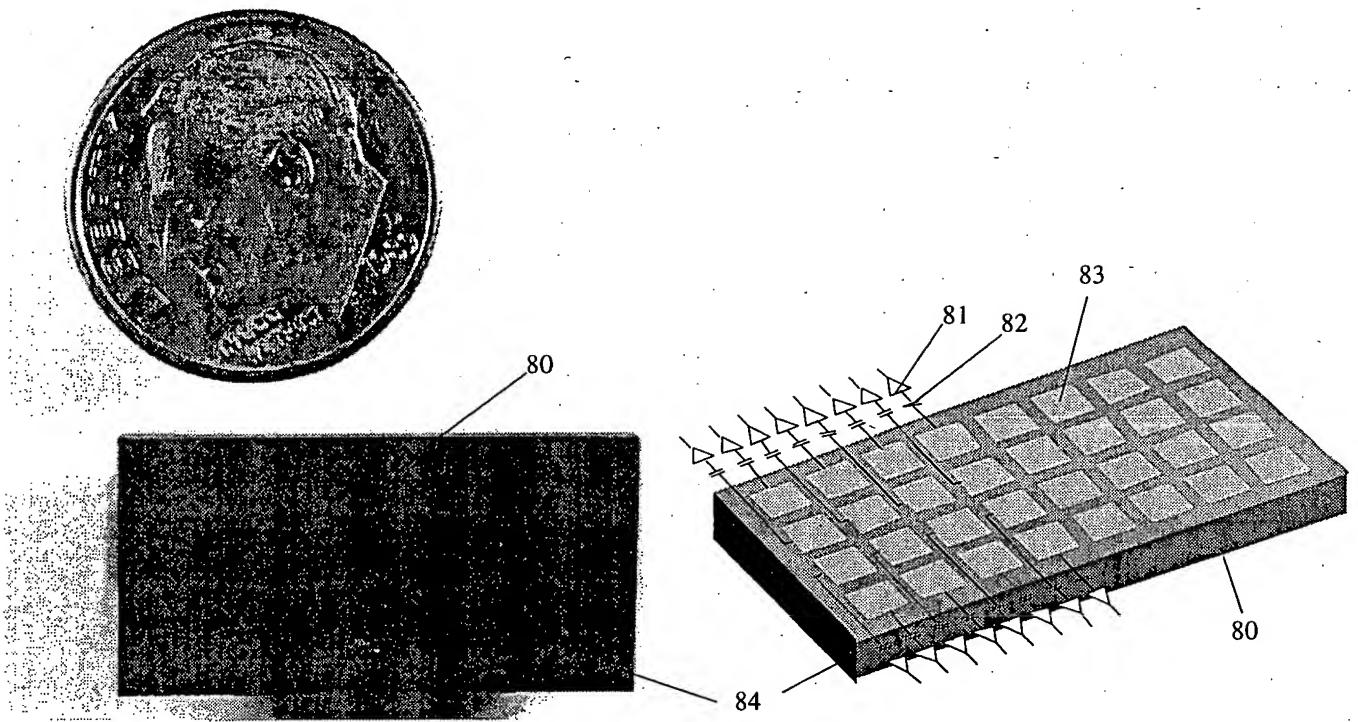


FIG. 4

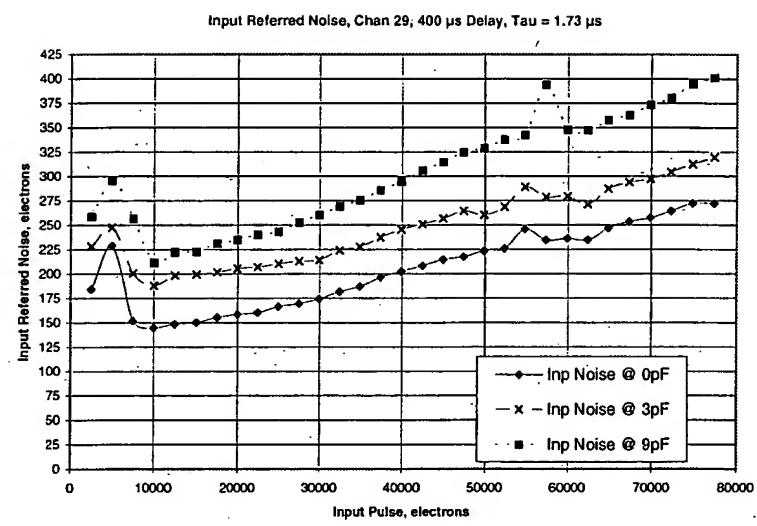


FIG. 5

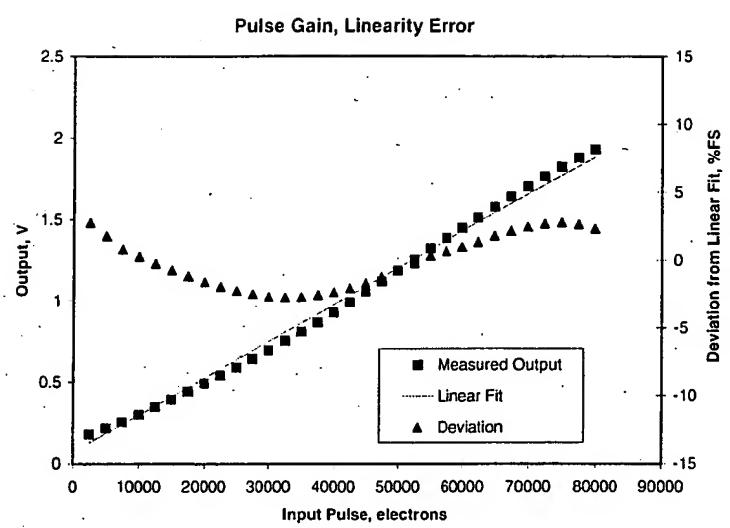


FIG. 6

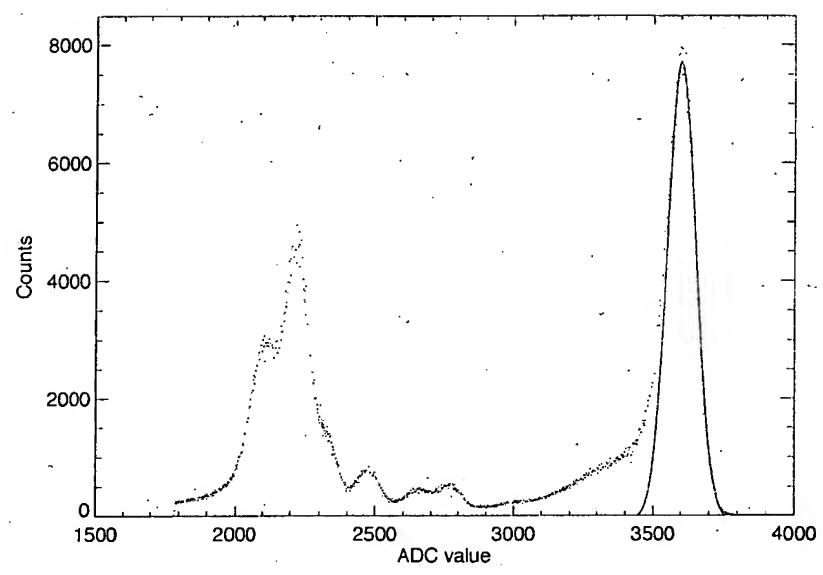


FIG. 7

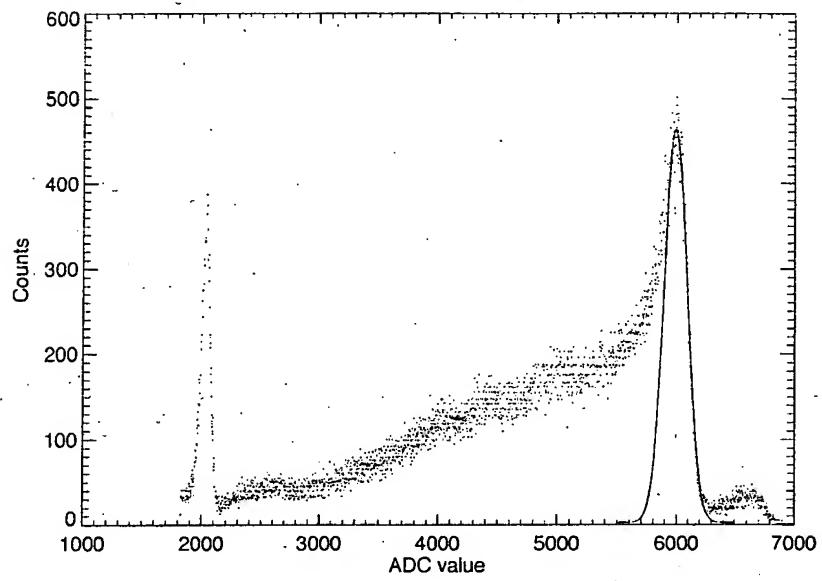


FIG. 8

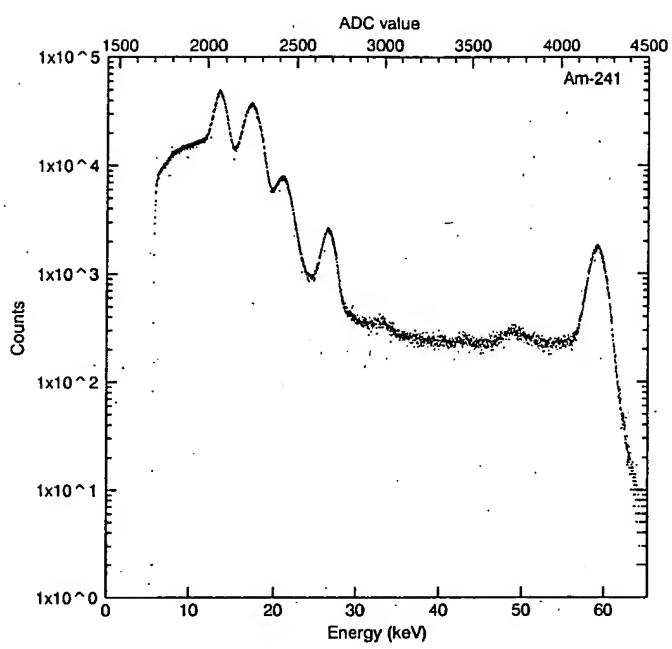


FIG. 9

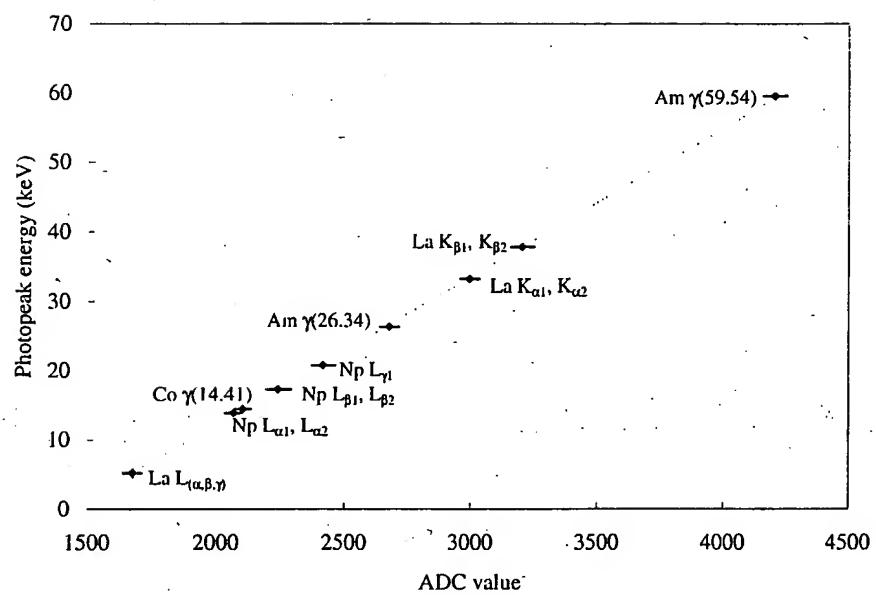
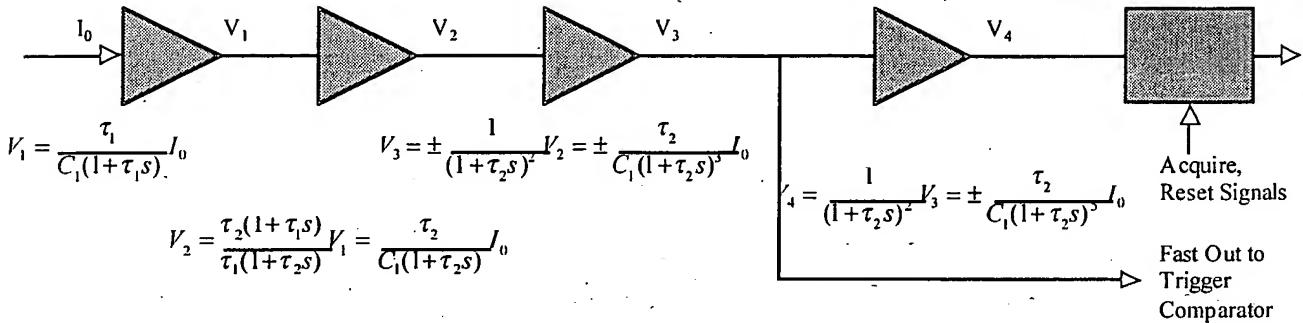


FIG. 10

Low-noise high linearity
integrator

Pulse Shaping Filter Stage 1

Differentiator and pole-zero
cancellation



Input Signal Characteristics (One Typical Case):

$$I_0 = I_{dc} + I_n + I_s$$

$$-100 \text{ pA} < \pm I_{dc} < 5 \text{ nA}$$

I_n : white noise, amplitude $< 20 \text{ fA}/\sqrt{\text{Hz}}$

$I_s = \pm (\epsilon Q/\tau_e)(\Theta(t-t_0) - \Theta(t-t_0-\tau_e)) + ((1-\epsilon)Q/\tau_h)(\Theta(t-t_0) - \Theta(t-t_0-\tau_h))$ (this is the signal for a single event occurring at time t_0)

τ_e (electron collection time constant) $\approx 50 \text{ ns}$ (a 2mm planar CdZnTe detector @ 300 V)

τ_h (hole collection time constant) $\approx 550 \text{ ns}$ (a 2mm planar CdZnTe detector @ 300 V)

ϵ (electron fraction of signal charge) : independent random number $0 < \epsilon < 1$, approximately uniform distribution (worst case)

t_0 (time of event) : these are random (following a Poisson process), average rate $\lambda < 10 \text{ kHz}$ per channel

Q (signal charge) : $0 < Q < \text{FSR}$; the purpose of the ASIC is to measure this Q for each event, as best as possible

Notes:

- At V_1 (and other internal nodes of the first two stages, the signal components due to I_{dc} and I_n may be comparable to or larger than that due to I_s). Therefore linearity is critical.
- The input node is loaded with a capacitance C_d to ground, $0 < C_d < 50 \text{ pF}$.
- Signal polarity selection is shown in the third stage, for example. It could be elsewhere, before the peak detector and trigger pick-off.
- The purpose of this ASIC is to measure Q for each event, in so far as possible producing an answer independent of I_{dc} , t_0 , ϵ , λ , and the noise sources, including I_n as well as any internal noise sources.
- Measurement of Q proceeds by read-out of the peak detector at some time after the event time t_0 (followed by reset of the peak detector as promptly as feasible).

FIG. 11

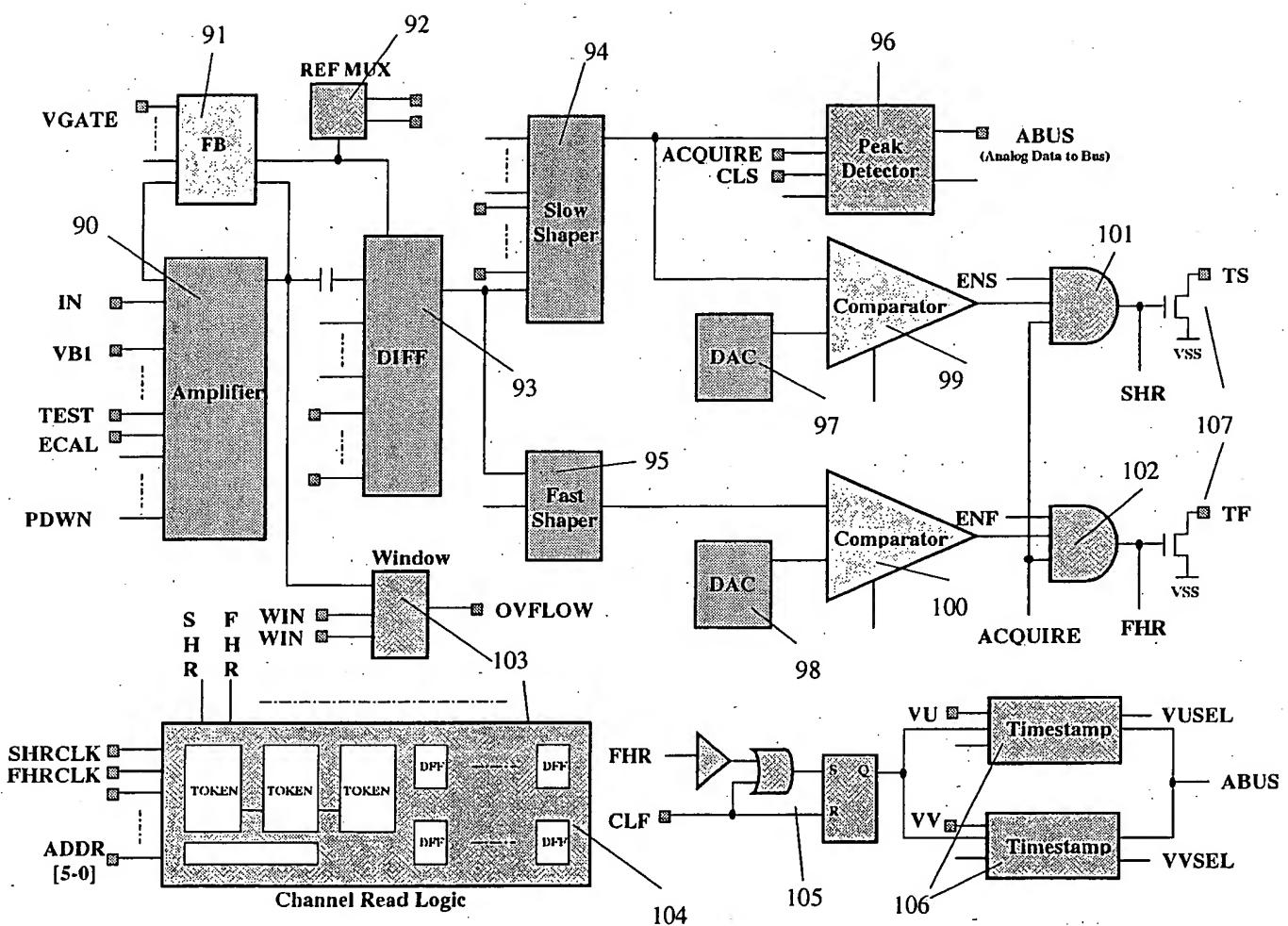


FIG. 12